

PATENT ABSTRACTS OF JAPAN

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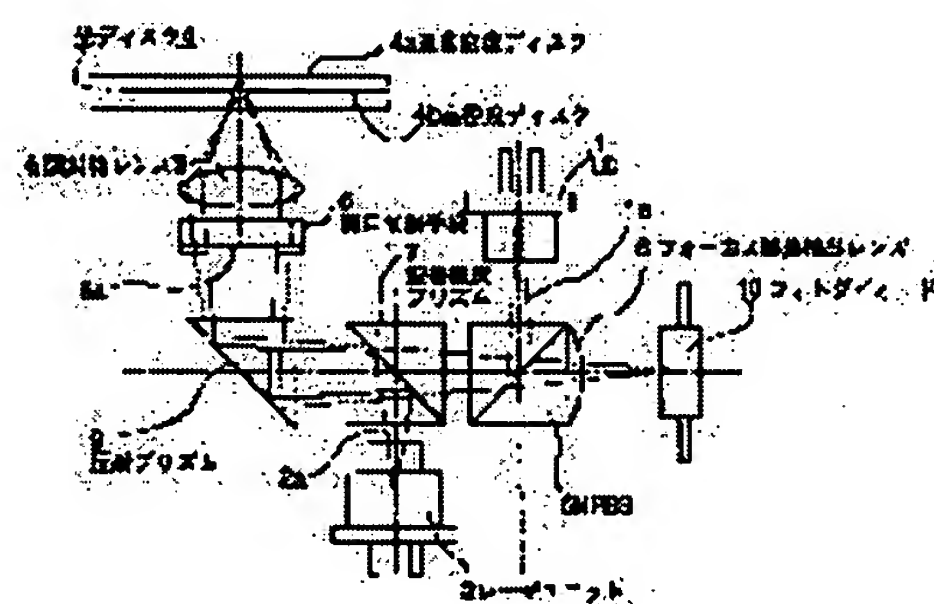
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(54) OPTICAL INFORMATION RECORDING/REPRODUCING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To realize a small-sized, light-weighted and inexpensive optical information recording/reproducing device capable of recording/reproducing optical disk media of plural standards with different disk thickness and recording density in high performance.

SOLUTION: This device consists of a finite system objective lens 3a of NA 0.6 designed for the disk thickness 0.6mm, an aperture limit means 5 switching an effective size of laser light incident on the finite system objective lens, a beam splitter 6 branching the reflection light from an information medium and a photodetector 10, etc., converting return light to an electric signal, and deals with two kinds of information media with different disk thickness by switching a lens effective size by the aperture limit means 5. Further, the opening part shape of the aperture limit means 5 is made an elliptic shape opening that a lens track moving direction becomes the minor axis.



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CLAIMS

[Claim(s)]

[Claim 1] The optical information record regenerative apparatus with which the opening control means which is the optical information record regenerative apparatus which performs writing or read-out by the laser beam through an objective lens to the information media from which disk thickness differs, and controls opening according to an information media before an objective lens is provided, and said opening is characterized by being elliptical [from which the lens truck migration direction serves as a minor axis].

[Claim 2] The optical information record regenerative apparatus of claim 1 characterized by using the laser beam of different wavelength according to an information media, and opening of said opening control means changing according to wavelength.

[Claim 3] The optical information record regenerative apparatus of claim 2 characterized by said opening control means consisting of wavelength filter film.

[Claim 4] The optical information record regenerative apparatus of claim 2 characterized by said opening control means consisting of deviation filters.

[Claim 5] The optical information record regenerative apparatus of claim 2 characterized by consisting of bases in which said opening control means had a hologram field.

[Claim 6] The finite system objective lens of high numerical aperture, and the laser diode which emits light in laser, The opening limit means which changes the effective diameter of the laser light which carries out incidence to said finite system objective lens, The beam splitter which branches the reflected light from said information media to a photodetector side, In the optical information record regenerative apparatus which records two kinds of information medias from which disk thickness differs by changing a lens effective diameter with said opening limit means including the photodetector which changes return light into an electrical signal, and is reproduced The optical information record regenerative apparatus with which the opening configuration of said opening limit means is characterized by being elliptical opening from which the lens truck migration direction serves as a minor axis.

[Translation done.]

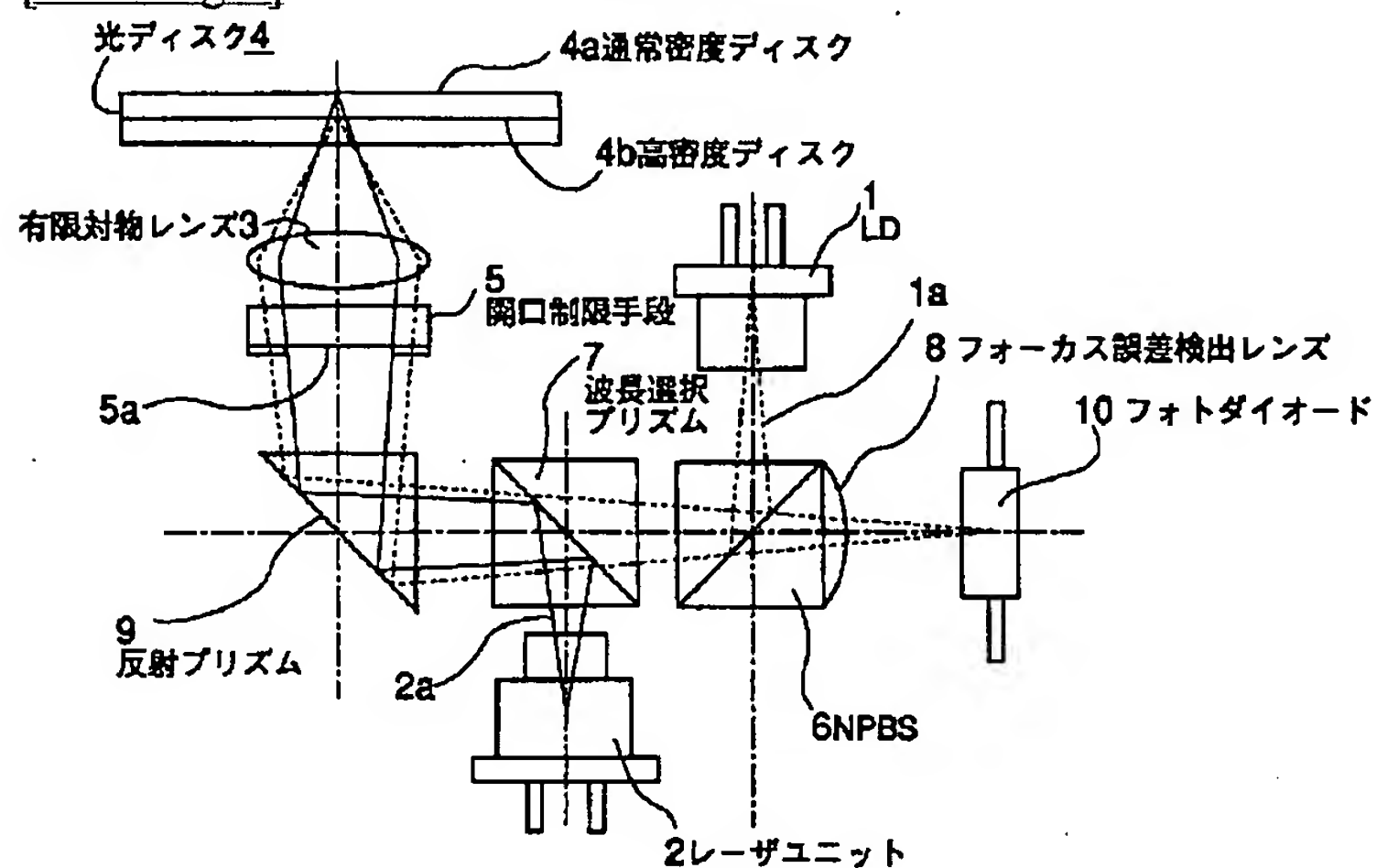
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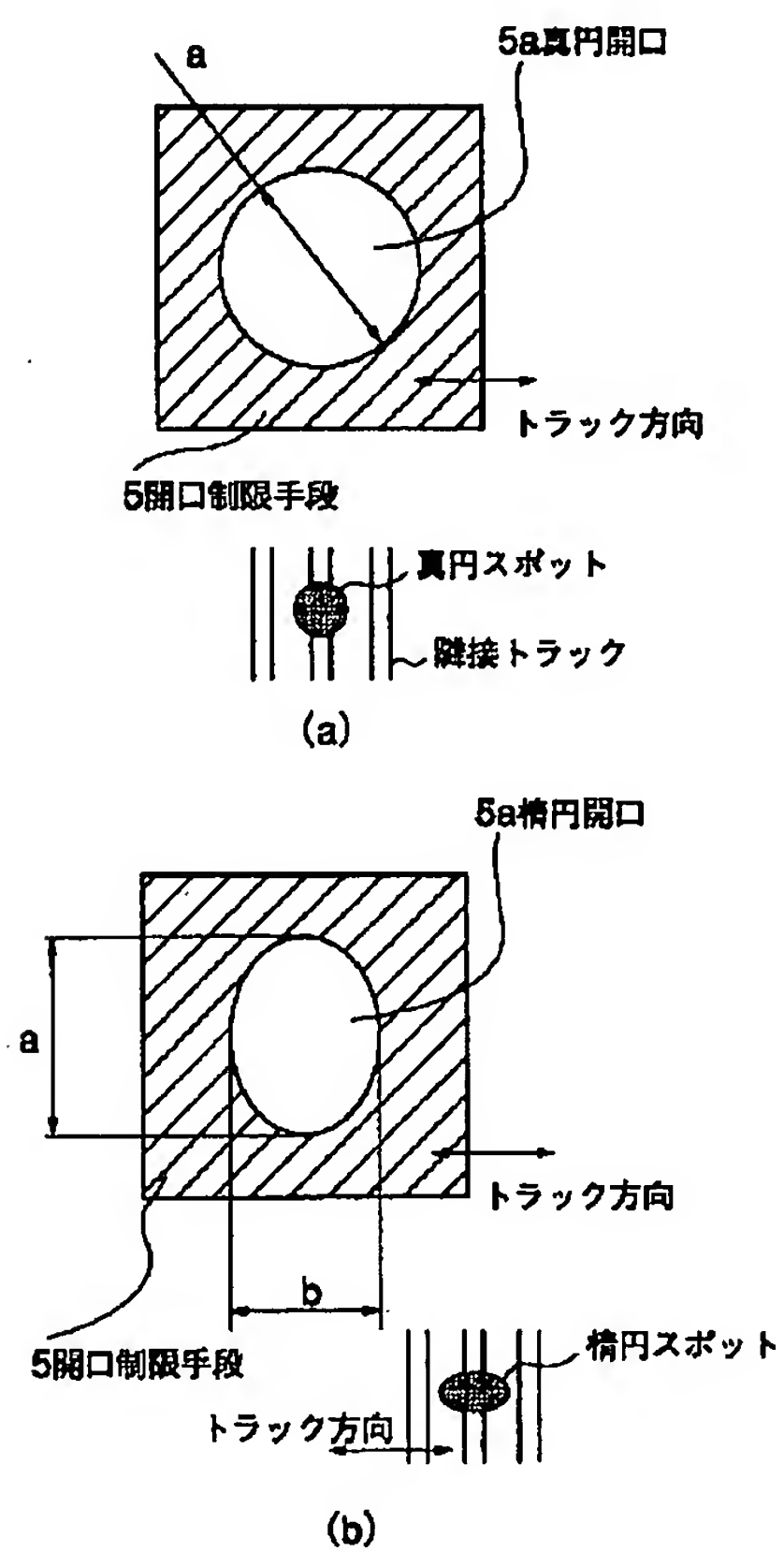
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DRAWINGS

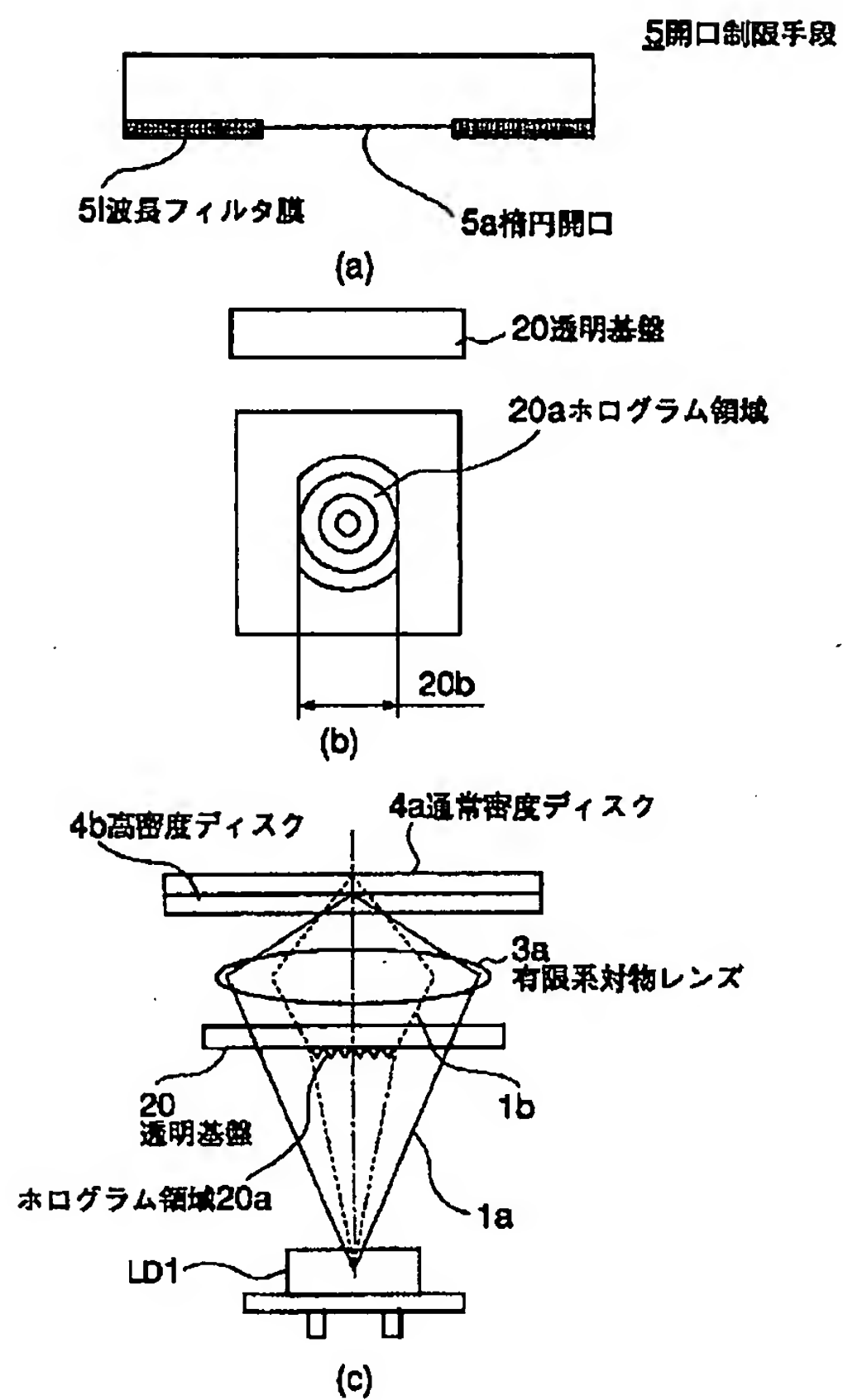
[Drawing 1]



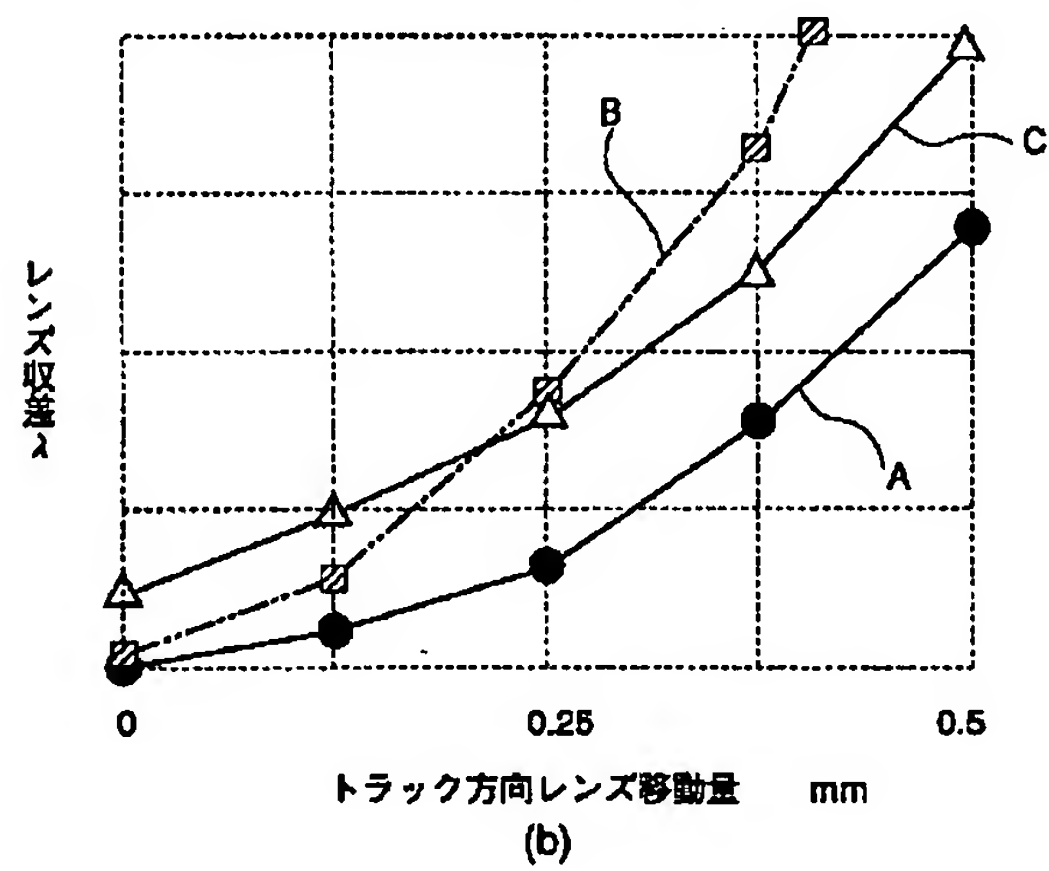
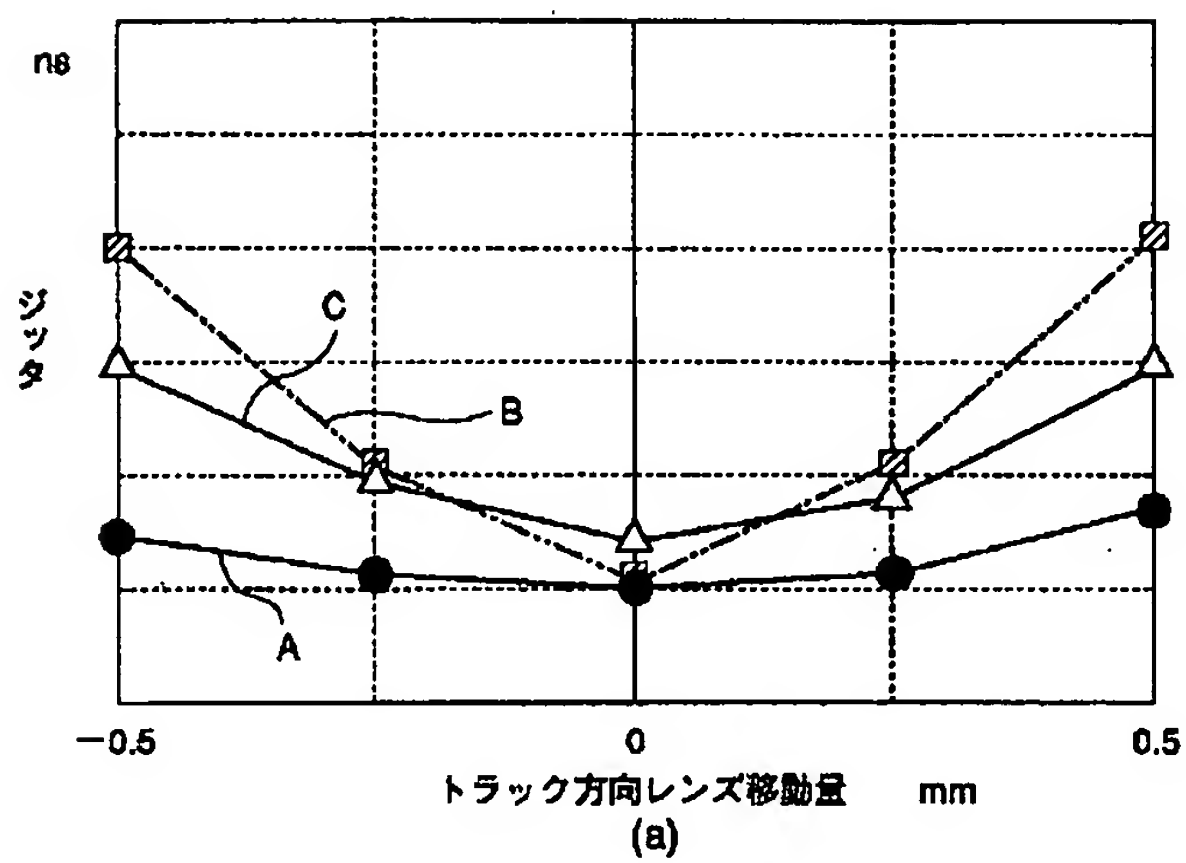
[Drawing 2]



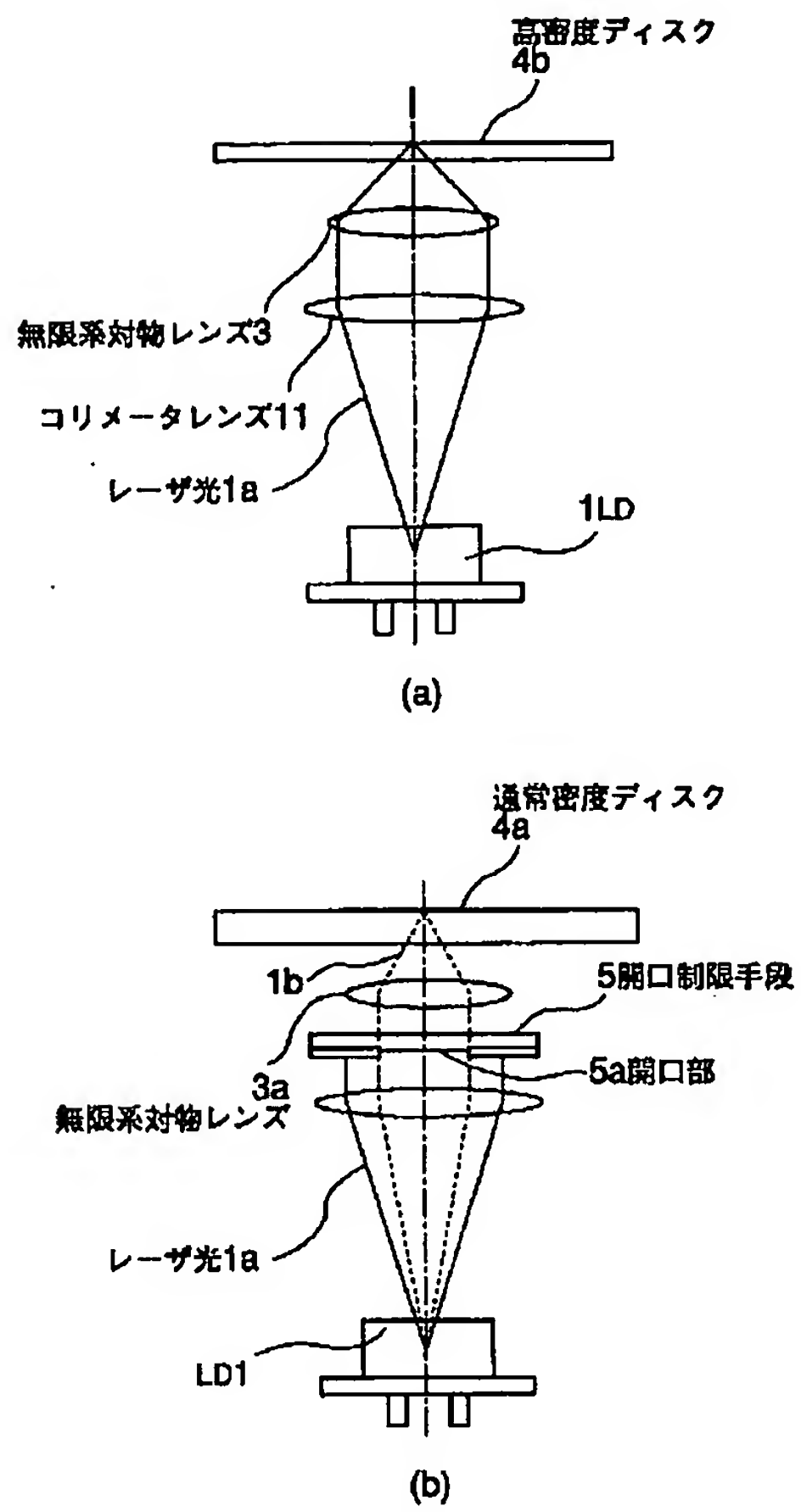
[Drawing 3]



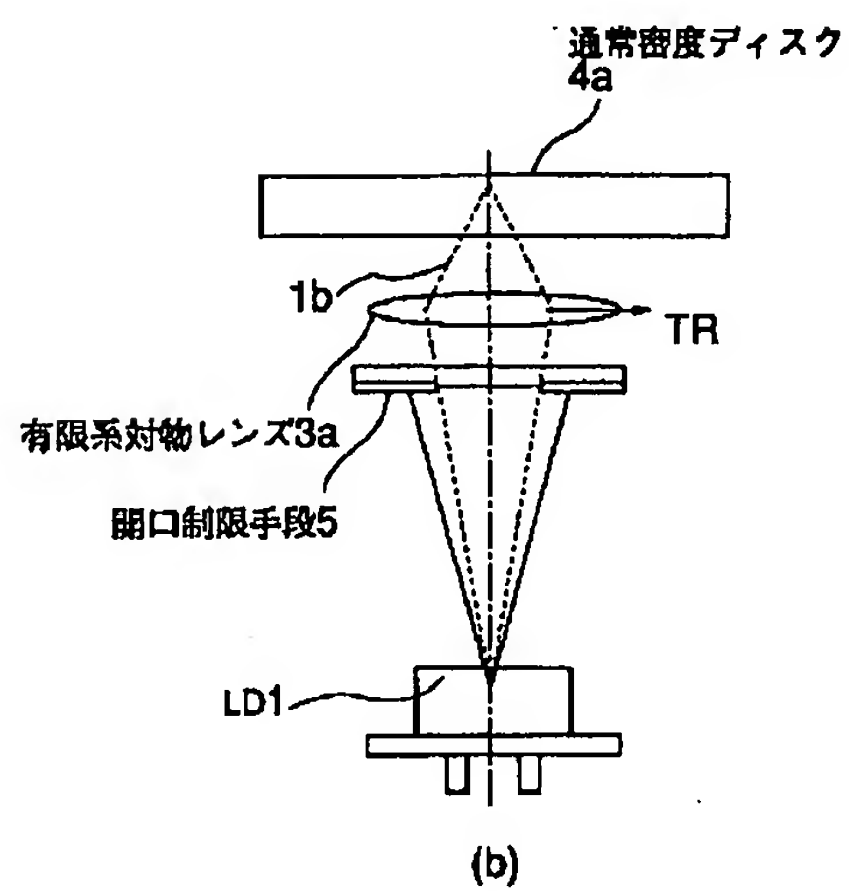
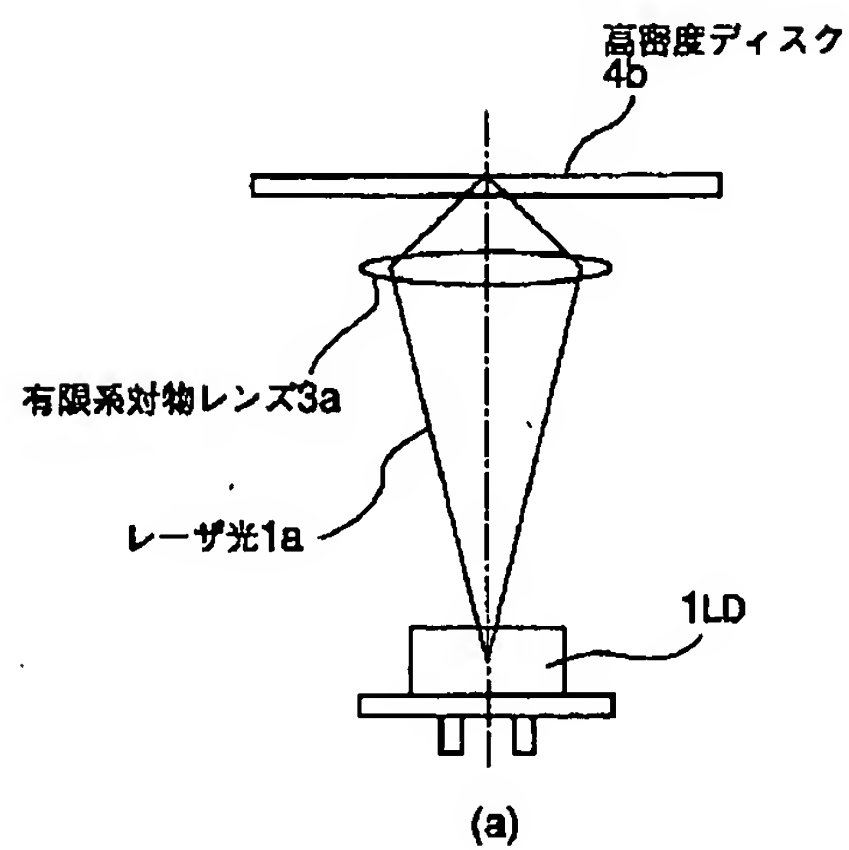
[Drawing 4]



[Drawing 5]



[Drawing 6]



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]

[Field of the Invention] This invention relates to the optical information record regenerative apparatus which performs the writing and read in of optical information to the various optical disks with which thickness differs.

[0002]

[Description of the Prior Art] For example, some approaches are proposed in order to carry out record playback of both the high density light information media of 0.6mm of disk thickness, and the conventional consistency information medias (CD etc.) of 1.2mm of disk (DVD etc.) thickness with one optical regenerative apparatus. There are the so-called twin lens method which drives two objective lenses designed the the best for each disk thickness with one lens actuator, 2 focal methods which build two foci by the hologram, respectively, an opening limit method which changes the diameter of drawing of a lens in this.

[0003] This inventions are amelioration of an opening limit method, and a development mold, and, for this reason, are extracted and explained to the opening limit method in the various above-mentioned methods as a conventional example.

[0004] Drawing 5 explains the conventional opening limit method briefly. In order to reproduce correctly the information recorded on the disk or to record high-density information on a disk, it is important to form a minute spot without aberration on a disk information side. Therefore, by explanation of this conventional example, only the outward trip in the conventional information record regenerative apparatus explains.

[0005] Drawing 5 (a) shows record of a high density light information media, and a playback condition. The laser light to which outgoing radiation of laser diode (henceforth referred to as LD) and the 1a was carried out for 1 from said LD, and 11 are [an infinity system objective lens and 4b of a collimator lens and 3] high density light information medias (it is henceforth called a high-density disk) with a thickness of 0.6mm, and said objective lens 3 is designed so that it can record the optimal and said high-density disk can be played. Now, laser light 1a which emitted LD1 becomes parallel light with a collimator lens 11, and carries out incidence to the infinity system objective lens 3. The parallel flux of light which carries out incidence to an objective lens at this time has a diameter of opening restricted by the lens diaphragm which is not illustrated. For example, it is restricted to NA0.6 at the time of high-density disk playback. The laser condensed with the lens 3 forms a minute spot with little aberration in information side 4b of a high-density disk.

[0006] Next, drawing 5 (b) explains record of a usual consistency light information media (it is usually henceforth called a consistency disk) with a thickness of 1.2mm, and a playback condition. In (b), it has composition which inserted the opening limit means 5 between the collimator lens 11 and the infinity system objective lens 3. By opening 5a of said opening limit means 5, laser light 1a which emitted LD1 and became parallel light with the collimator lens 11 has the flux of light restricted, and carries out incidence to an objective lens 3. The diameter of opening restricted at this time makes a circular

configuration, and is set to the usually optimal opening 0.45 for a consistency disk, for example, NA. This usually forms a spot with little aberration in a consistency disk information side.

[0007] Usually, the opening limit means 5 and the infinity system objective lens 3 have composition held and driven to coincidence with the lens actuator which is not illustrated, and usually enable record of a consistency disk, and playback with one infinity system objective lens 3 designed for high-density disks by the existence of insertion of the opening limit means 5. It has set for the opening limit means 5, and the approach of shoes is proposed. There are a deviation filter using the deviation direction of laser, a wavelength filter using the difference in the wavelength of laser, an only structural shutter method, etc.

[0008] Since the optical information record regenerative apparatus of drawing 5 had a collimator lens 11, the optical path length became long and it had the problem that the miniaturization of the whole equipment and thin-shape-izing were difficult. The configuration by the formation of a finite system of an objective lens as shown in drawing 6 (a) for that and (b) was able to be considered. Finite system objective lens 3a is designed so that the optimal property for record of high-density disk 4b and playback may be acquired. In drawing 6 a, according to the lens diaphragm which is not illustrated, laser light 1a which emitted LD1 has opening set up by NA0.6, and carries out incidence to finite system objective lens 3a. The laser light condensed by finite system objective lens 3a forms a minute spot with little aberration in a high-density disk information side. Next, at the time of record of consistency disk 4a, and playback, the opening limit means 5 is usually considered as the configuration which inserted between objective lens 3a and LD1 like infinity optical system. By opening 5a of the opening limit means 5, laser light 1a which emitted LD1 has a diameter of opening restricted, and carries out incidence to finite objective lens 3a. The restricted diameter of opening makes a circular configuration, and is set to the usually optimal opening 0.45 for a consistency disk, for example, NA. This usually forms a spot with little aberration in a consistency disk information side. At this time, finite system objective lens 3a and the opening limit means 5 are held and driven to the lens actuator which is not illustrated at coincidence.

[0009]

[Problem(s) to be Solved by the Invention] While small [of the whole equipment] and thin shape-ization were attained in the case of the optical system using this finite objective lens, there was a big problem which degradation of the reproducing characteristics outside a shaft of a consistency disk usually explains to utilization below greatly.

[0010] Generally in the case of finite optical system, the image quantity property of a lens and the optical-axis migration property are inferior compared with infinity optical system, but with CD, finite optical system has become in use by the system design of the whole equipment, and, naturally adoption of finite optical system is considered by high density optical disks, such as DVD. Although the engine performance as an infinity system objective lens in which the finite objective lens of the engine performance on a shaft designed for high-density disks is also the same is obtained, the part which is inferior to infinity optical system in axial extraversion ability will be corresponded in the system design of the whole equipment. However, performance degradation if it is going to apply two or more specification medium of drawing 6 (a) and (b) to record and a refreshable optical information record regenerative apparatus, to the extent that reproducibility ability outside a shaft of a consistency disk cannot usually respond it only by the system design of said whole equipment generates this finite optical system.

[0011] Next, drawing 4 (a) and (b) explain the trouble. Drawing 4 (a) is a graph showing jitter change of the usual consistency disk regenerative signal when moving various finite system objective lenses in the direction of a disk track. A in a graph is the property of the regenerative apparatus which consists of optical system of the finite system objective lens usually designed only for the consistency (disk CD) playbacks. Even if a lens moves and image quantity occurs, the reproducibility ability by which degradation of a jitter was stabilized few is obtained. The inside B of a graph is a jitter property when usually playing a consistency disk by the optical system which consists of a finite objective lens for high-density disks shown in drawing 6 , and an opening limit means. If a lens moves and image quantity

occurs, a jitter will deteriorate rapidly. C is the property of this invention mentioned later.

[0012] The image quantity property of finite system objective lens wave aberration shown in drawing 4 (b) can explain these phenomena. The inside A, B, and C of a graph corresponds to A, B, and C of drawing 4 (a). Usually, in the case of the optical system B by the finite system objective lens for high-density disks, and the opening limit means, compared with objective lens only for consistency disks A, shaft top aberration is made to about 0, but the degradation degree of the wave aberration by lens migration is large, and, the way things stand, a problem occurs practically.

[0013] Then, the purpose of this invention is offering the cheap and small optical information record regenerative apparatus which is proposed in view of this conventional actual condition, and can reproduce and record efficiently the information on the optical disk medium of two or more specification.

[0014]

[Means for Solving the Problem] The finite system objective lens of NA0.6 which the optical information record regenerative apparatus of this invention was proposed in order to attain the above-mentioned purpose, for example, was designed for 0.6mm of disk thickness, The opening limit means which changes the effective diameter of the laser light which carries out incidence of the laser to the laser diode which emits light, and a finite system objective lens, The lens actuator which holds a finite system objective lens and an opening limit means to coincidence, and is driven in the direction of a focus and the direction of a truck of an information record medium, The beam splitter which branches the reflected light from an information media to a photodetector side, Including the photodetector which changes return light into an electrical signal, two kinds of information medias from which disk thickness differs are recorded, and it reproduces by changing a lens effective diameter with an opening limit means, and is characterized by making the opening configuration of an opening limit means elliptical [from which the lens truck migration direction serves as a minor axis].

[0015] In this invention, NA of the direction of a truck becomes small by having used the opening limit means of an ellipse opening configuration, degradation of wave aberration can be made small, and the optical disk of two or more specification medium can be stabilized and played [record and] using the high NA finite objective lens of a piece.

[0016]

[Embodiment of the Invention] Next, the gestalt of operation of the optical information record regenerative apparatus of this invention is explained, and the configuration of this invention and an operation are clarified.

[0017] First, the opening configuration of the opening limit means of this invention is explained using drawing 2. Drawing 2 (a) shows the conventional opening configuration, and opening 5a is a perfect circle configuration. The diameter a of opening circles is set up so that this may become the usually optimal numerical aperture NA for consistency disk playback. On the other hand, the opening configuration of the opening limit means of this invention has elliptical opening 5a which serves as Monopodium b in the tracking migration direction (the drawing Nakaya mark direction) of a lens as shown in drawing 2 (b). The axial length a by the side of a major axis is conventionally the same as the diameter a of opening circles.

[0018] Making the diameter of opening small in the direction of a truck like this invention will make small lens numerical aperture NA of the direction of a truck, and it will separate from an original optimum design value. The spot configuration on the disk extracted by ellipse opening also turns into elliptical [long in the direction of a truck as shown in (b)], and the cross talk between trucks gets worse. However, as shown in the graph C of drawing 4 (b), the wave aberration degradation degree at the time of the part lens migration to which NA became small is sharply improvable compared with the case of the opening configuration B conventionally. An extensive improvement is attained as a jitter property is also shown in the graph C given in drawing 4 (a) in connection with this. In addition, although the initial aberration on a shaft and the jitter engine performance get worse compared with the conventional example, they do not pose a problem practically. The optimal opening configurations also including a part for said cross talk can be searched for from count and experimental data.

[0019] Although the technique of the conventional opening limit means is supported as a concrete method of the opening limit means 5 and the approach of shoes can be considered, elliptical [of this invention] is fundamentally applicable also to the case of which method.

[0020] Drawing 3 (a) shows an opening limit means by which the wavelength filter film 51 which penetrates a specific wavelength range and intercepts a predetermined wavelength range was formed on the clear glass base. For example, in case a high-density disk is recorded and it reproduces, 635nm LD is used. In this case, 635nm laser light penetrates all the fields of ellipse opening 5a and the wavelength filter film section 51 without the filter film, and faces to a finite system objective lens. Next, at the time of record of a consistency, and playback, 780nm LD is usually used. 780nm laser light penetrates ellipse opening 5a without a filter, and it is reflected in respect of [51] a wavelength filter, and as a result, 780nm laser light is restricted to the flux of light elliptical [narrow in the direction of a truck], and faces to a finite objective lens. Moreover, a deviation filter can also realize structure of (a). Said thing [restricting the diameter of opening similarly by changing 90 degrees by the approach of not illustrating the straight-line deviation direction of the laser light which carries out incidence to the opening limit means 5] is possible.

[0021] Drawing 3 (b) is the example of the ellipse opening limit means using a hologram. The conventional opening configuration forms the hologram of a concentric configuration on a transparence base, and the primary diffracted light carries out incidence to an objective lens with the numerical aperture usually optimal for consistency disk playback. The example which applied ellipse opening of this invention to the hologram is realizable by deleting the direction periphery of a truck of the conventional concentric configuration hologram field 20a formed on the transparence base 20 to predetermined dimension 20b.

[0022] Drawing 3 (c) shows the equipment configuration at the time of using the ellipse opening limit means shown in (b), and carries out incidence of the laser light 1a which emitted LD1 to a hologram method ellipse opening limit means. Hologram field 20a has sufficient area, in order to make the low NA flux of light usually used for consistency disk playback, and all the zero-order transmitted lights of 1a which contains the zero-order transmitted light of said hologram field 20a at the time of record of a high-density disk and playback carry out incidence to finite objective lens 3a. The laser light condensed with the finite objective lens forms a minute spot with little aberration in high-density disk information side 4b. Next, in case record playback of the consistency disk is usually carried out, primary diffracted-light 1b of ellipse hologram field 20a is used. Incidence of the primary diffracted-light 1b of 20a is carried out to the finite system objective lens 3 by the elliptical flux of light narrow in the direction of a truck according to an operation of hologram field 20a of said ellipse opening configuration. The laser light condensed with the finite system objective lens 3 usually forms a spot with little aberration in consistency disk information side 4a.

[0023] Next, the gestalt of operation of the optical information record regenerative apparatus using an ellipse opening limit means with a wavelength filter is explained with reference to drawing 1 .

[0024] The gestalt of operation of drawing 1 consists of the short wavelength (635nm) laser 1, the 780nm laser unit 2 with a built-in detection system and NA0.6 finite objective lens 3 for high-density disk playback, an optical disk 4, the wavelength filter method ellipse opening limit means 5, the non-deviated beam splitter (NPBS) 6, the wavelength selection prism 7, the focal error detection lens 8, the internal reflection prism 9, and photodiode 10 grade. Moreover, the wavelength filter 5 of an ellipse opening configuration is shown in drawing 2 (b) and drawing 3 (a).

[0025] It reflects the about 50% by NPBS6, and incidence of the short-wavelength-laser light 1a which emitted 635LD1 is carried out to the wavelength selection prism 7. The wavelength selection prism 7 penetrates 635nm efficiently (for example, 95% or more), and reflects 780nm efficiently. Therefore, most penetrates selection prism, it reflects by the internal reflection prism 9, and 635 laser 1a faces to the wavelength filter 5. 635 laser 1a penetrates the wavelength filter 5 whole surface (opening is included), and connects a minute spot with an objective lens 3 to high-density disk (DVD etc.) information recording surface 4b. The reflected light of a disk penetrates return, NPBS6, and the focal detection lens 8 to a laser side in the same path, and a focus is changed into it by the photodiode 10 at an

epilogue electrical signal.

[0026] 780nm laser light emits the 780nm laser unit 2, reflects efficiently the wavelength selection prism 7 and the internal reflection prism 9, and they carry out incidence to the wavelength filter 5. Only the 780nm laser light 2a which carried out incidence of the 780nm laser light to ellipse opening in order to restrict transparency opening by ellipse opening is condensed with an objective lens, and the wavelength filter 5 usually connects a spot to consistency disk (CD etc.) information recording surface 4a. Under the present circumstances, the amount of amendments of the spherical aberration by the focal distance by the side of a disk and the difference in disk thickness can be set as arbitration by setting the location of the direction of an optical axis of the point emitting [780nm side laser] light as a position. The 780nm disk reflected light is also changed into an electrical signal by the detection system in return and a unit by the same path to the laser unit 2. Moreover, since the internal reflection prism 9 indicated by this example satisfied a high reflection factor cheaply, although it made it into the internal reflection method without a wavelength dependency in the 635 to 780nm extensive wavelength band, it cannot be overemphasized that it is applicable with a surface reflective mirror method.

[0027] The opening limit means configuration in some this inventions explained until now acts in combination with that it is elliptical [which makes a monopodium in the truck migration direction of a finite objective lens], and the finite system objective lens by which the opening limit means elliptical [this] was further designed for high-density disks, and demonstrates the effectiveness.

[0028]

[Effect of the Invention] as mentioned above , according to this invention , NA of the direction of a truck become small by having use the opening limit means of an ellipse opening configuration , degradation of wave aberration can be make small , and the optical disk of two or more specification medium by which thickness and recording density be different irrespective of the approach of an opening limit means using the high NA finite objective lens of a piece can be stabilize and play [record and] , consequently it be cheap , and a thin shape and an optical small and lightweight information record regenerative apparatus can be realize .

[Translation done.]